

# NATURAL RESOURCES CONSERVATION SERVICE

## DOCUMENTATION REQUIREMENTS FOR

### GRASSED WATERWAYS

#### CODE 412

#### General

Design according to the guidelines in [Chapter 7 of National Engineering Handbook Part 650 \(NEH 650\)](#), [Engineering Field Handbook](#) and the criteria in Conservation Practice Standard 412, Grassed Waterway. Typical waterway cross sections are shown in Figure 1.

#### Surveys

The amount of survey information necessary to design the lined waterway or outlet will depend on the specific site conditions. In most cases, it will require a profile and cross section survey or a detailed topographic map.

#### Layout

Record survey data on Form NRCS-ENG-28, Loose Leaf Field Sheet and NRCS-ENG-29, Loose Leaf Field Sheet, or [Forms KS-ENG-37 and KS-ENG-37a, Field Notes](#). Record the information indicated below. Survey notes should follow the format shown in Figure 2 and Figure 3.

- Complete identification information on the front side of SCS-ENG-28.
- Record profile survey notes. Take shots along the centerline of the proposed waterway at all significant changes in slope and direction but do not exceed 100 feet between shots. On longer waterways with more than one instrument set-up, rod readings should be converted to elevations using a common bench mark.
- Record cross section notes. Take enough cross sections to adequately represent each waterway reach. A minimum of 1 cross section per reach is required.
- Length may be determined by pacing for design purposes. For long or complex

waterways, it is recommended that final measurement for design be made using a tape, chain, wheel counter, or similar device to ensure that the final recorded length is within allowable tolerance.

- The survey data shall extend a minimum of 100 feet past the waterway outlet and will include elevations and sizes of any road culverts, bridges, and road surfaces.

Where waterway slopes are greater than 1 percent, no complex shaping or gully-filling is required, and the design discharge is determined to be 40 cubic feet second (cfs) or less, surveys may consist of selected shots of all significant slope changes ( $\pm 1$  percent). Cross sections are also optional.

#### Design

(a) Design Tools – The Waterway Design Tool in the Engineering Field Tools software or the [Kansas Grassed Waterway Spreadsheet](#) may be used to design a waterway and complete construction plans.

(b) Reach Design - Changes in slope, increases in drainage area, and/or locations where precise shaping will be required (such as outlet ramps into streams or structures) generally determine the locations and lengths of waterway reaches. For long waterways, profile shots should be plotted on graph paper or in the selected design tool. This will aid the designer in determining the length and design slope of each reach. A sample plot is shown in Figure 4.

(c) Hydrology - Use [Form KS-ENG-137b, Hydrologic Summary Sheet](#), to record the hydrologic data for the waterway drainage area and to compute the peak discharge in cfs for each reach. The hydrologic summary sheet, or its equivalent, is included in both design tools referenced above. Runoff from a 10-year, 24-

hour frequency rainfall will normally be used for design. Include a map of the drainage area in the documentation.

Designs out-of-channel flow will generally be developed by the area engineering staff. For waterways with drainage areas of 60 acres or less, peak discharges may be selected from [Table KS2-17, Peak Rates of Discharge \(in cfs\) for Small Watersheds Using Type II Storm Distribution and Moderate Slopes \(3-7%\), in NEH 650](#).

(d) Hydraulic Design – Determine allowable stress and allowable velocity, then use the reach slopes from the above “Reach Design” section and the discharges from the above “Hydrology” section to design the waterway cross section dimensions. Tables in [Chapter 7 of NEH 650](#) or other approved tables and design tools may be used. Refer to [Table 1 in Conservation Practice Standard 412, Chapter 7 of NEH 650](#), and the [Kansas Supplement to Chapter 7 of NEH 650](#) for further information on allowable stress and allowable velocity.

(e) Field Sheet for Trapezoidal Grassed Waterway, Form KS-ENG-39 (or equivalent):

Record the following items on this field sheet.

- (1) Name of owner/operator.
- (2) Identity number. The tract number or a number assigned for cost-share program identification may be recorded in this blank.
- (3) Legal description.
- (4) County.
- (5) Signature of person performing the design and the date.
- (6) Signature of person checking the design and the date.
- (7) Signature of person approving the design and the date.
- (8) Signature of person performing the layout and the date.
- (9) Enter the scale of the location map.

(10) Complete the location map, showing the location of the practice(s); and any other pertinent features, such as streams, roads, farmsteads, etc.

(11) Complete the "Hydraulic Design" section for each waterway reach. Hydrologic soil group, curve number, drainage area and discharge may be taken from KS-ENG-137 (or the peak discharge tables for small drainage areas). Channel grade, velocity and capacity retardance, and design velocity may be taken from the hydraulic design tables or calculations.

(12) The "Remarks" section may be used to indicate any information specific to the job, such as bench mark location, design notes, etc.

(13) Complete the "Design Dimensions" table for each waterway reach. Depth, bottom width and side slopes may be taken from the hydraulic design tables or calculations. Indicate the depth of freeboard, if any. Indicate the top width and side slopes of the berms and whether the berms are temporary or permanent. If an inter-terrace strip is to be shaped adjacent to the waterway, indicate the strip width or side slope.

(14) Indicate the number and letter of each waterway reach in the "Design Shaped, Topsoiled, and Seeded Areas" table.

(15) Design length for each reach is taken from the layout survey notes or a plot of the waterway profile.

(16) Record the design shaped width for each reach. The shaped width is the top width calculated at the design constructed depth. Design constructed depth is the sum of the maximum design flow depth plus freeboard (if any). The width of any inter-terrace strips is added to the waterway shaped width to arrive at the total design shaped width.

(17) Record the design topsoiled width. Unless conditions dictate otherwise, the topsoiled width is the same as the design bottom width.

(18) Record the design seeded width. This width is the distance between the outside toes of the berms plus the width(s) of any inter-terrace strip(s). Seeded width may be measured from the plotted cross sections or may be calculated using the design dimensions and estimated

berm heights. Seeding temporary berms is recommended but not required. Refer to section (g) below for information regarding grass seeding field sheets.

(19) Calculate and record the design shaped, topsoiled and seeded areas to the nearest 0.01 acre.

(20) Plot the most representative cross section(s) for each reach. Show the waterway reach number and letter, and the station where the cross section was taken. Plot the cross section of the original ground line and then plot the design cross section of the waterway around this line. Dimension the bottom width, constructed depth, and side slopes. Also dimension the berms. Note or dimension the seeded width if different than shaped width. Horizontal and vertical scales used in plotting should be clearly evident. Sample cross sections are shown in Figure 5.

(f) Field Sheet for Parabolic Grassed Waterway, Form KS-ENG-40 (or equivalent):

Record the following items on this field sheet.

(1) - (13) These steps are the same as those listed for trapezoidal waterways; refer to section (d) above, steps (1) - (13), for details.

(14) Complete the "Design Dimensions" table for each waterway reach. Top width and constructed depth at the centerline (1.0 D) are obtained from hydraulic design tables or calculations. Quarter-points (1/4 points) must be calculated as shown under the "Parabolic Cross Section" portion of this table. For waterways with top widths less than 80 feet, use of the "0.5 Depth – At 3/8 TW" quarter-point is optional. Refer to the diagram in Figure 1 for further explanation of quarter-points.

Indicate the top width and side slopes of the berms and whether the berms are temporary or permanent.

(15) Indicate the number and letter of each waterway reach in the "Design Shaped Area and Seeded Area" table.

(16) Design length for each reach is taken from the layout survey notes or a plot of the waterway profile.

(17) Record the design shaped width for each reach. The shaped width is the top width calculated at the design constructed depth. Design constructed depth is the sum of the maximum design flow depth plus freeboard (if any). The top width may be taken from the "Design Dimensions" table. The width of any inter-terrace strips is added to the waterway shaped width to arrive at the total design shaped width.

(18) Record the design topsoiled width. Unless conditions dictate otherwise, the topsoiled width will generally be half the top width; that is, the distance between the "0.75D - TW/4" quarter-points.

(19) Record the design seeded width. This width is the distance between the outside toes of the berms plus the width(s) of any inter-terrace stripes). Seeded width may be measured from the plotted cross sections or may be calculated using the design dimensions and estimated berm heights. Seeding temporary berms is recommended but not required. Refer to section (g) for information regarding grass seeding field sheets.

(20) Calculate and record the design shaped, topsoiled and seeded areas to the nearest 0.01 acre.

(21) Plot the most representative cross section(s) for each reach. Show the waterway reach number and letter and the station where the cross section was taken. Plot the cross section of the original ground line and then plot the design cross section of the waterway around this line. Dimension the top width, centerline depth, and the depth at and distance to the quarter-points. Also dimension the berms. Note or dimension the seeded width if different than the shaped width.

Horizontal and vertical scales used in plotting should be clearly evident.

(g) [Form KS-ECS-4, Grass Seeding](#), should be completed for each waterway job requiring permanent vegetation. Refer to the Kansas Conservation Practice Standard and Specifications 342, Critical Area Planting, for waterway seeding information. Completion of this form may be delayed until checkout so that as-built areas may be used in the seed and fertilizer quantity computations. The district

conservationist is responsible for development and technical approval of seeding plans and specifications.

(h) Designs for waterways with triangular ("vee") cross sections may be documented on Form KS-ENG-39. Indicate zero bottom widths in the "Design Dimensions" table, and note that waterways are to be shaped to a triangular cross section in the "Remarks" section.

### Checkout

Use [Form KS-ENG-39a, Grassed Waterway \(Trapezoidal\) Checkout](#), or [Form KS-ENG-40a, Grassed Waterway \(Parabolic\) Checkout](#).

Record the following items on the field sheet. The items apply to each of the checkout field sheets. A sample of Form KS-ENG-39a is shown on page KS583-19, and a sample of Form KS-ENG-40a is shown on page KS583-23. The circled letters on each form correspond to the lettered items indicated below.

- (a) Name of owner/operator.
- (b) Identity number. The tract number or a number assigned for cost-share program identification may be recorded in this blank.
- (c) Legal description.
- (d) County.
- (e) Name of the contractor.
- (f) Signature of the person performing checkout and the date.
- (g) Signature of the person performing the audit and the date.
- (h) Type of measuring device used.
- (i) Calibration factor for the measuring device. The measuring device should be frequently checked and recalibrated if necessary.
- (j) Under the "Construction Checkout" section, record a minimum of one cross section per reach. Indicate the counter or measuring device reading and the length of the reach. Record the reach being checked and the station where the cross section was taken. Take the shots and measure the distances indicated on the cross

section drawing and record them in the blanks provided on the form. Additional cross section blanks are provided on the back of each form. For temporary-berm waterways, the constructed depth is measured from the lowest field-side elevation. For permanent-berm waterways, the constructed depth is measured from the top of the berm.

(k) Under the "Checkout Shaped, Topsoiled and Seeded Areas" table, record the waterway number and reach letter.

(l) Record the checkout length of each waterway reach. This length is taken from the "Length" blank of each checkout cross section [see (j) above].

(m) Record the design shaped and topsoiled widths. These are taken from the "Design Shaped, Topsoiled and Seeded Area" tables found on the front side of Forms KS-ENG-39 (trapezoidal waterway) and KS-ENG-40 (parabolic waterway).

(n) Record the checkout seeded width of each waterway reach. The checkout seeded width is the sum of the horizontal distances recorded on the checkout cross section. This includes the distance between the outside toes of the berms plus the width(s) of any shaped inter-terrace strip(s). It is recommended but not required that the widths of temporary berms be included in the checkout seeded width.

(o) Calculate and record the checkout shaped, topsoiled and seeded areas according to the formulas given under columns E, F and G on the checkout field sheets. Record these areas to the nearest 0.01 acre.

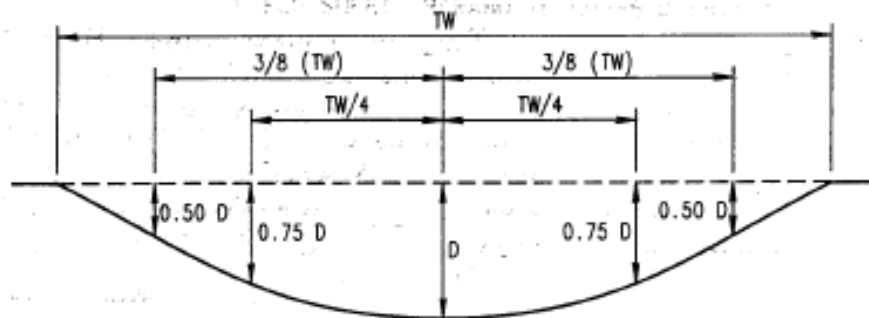
### Additional Checkout Guidance

It is recommended that the waterway slope be checked at each checkout cross section. Complete a profile survey if the waterway was required to be precisely excavated to a specific grade. Record the notes on Form NRCS-ENG-28, and NRCS-ENG-29, or [Forms KS-ENG-37 and KS-ENG-37a, Field Notes](#).

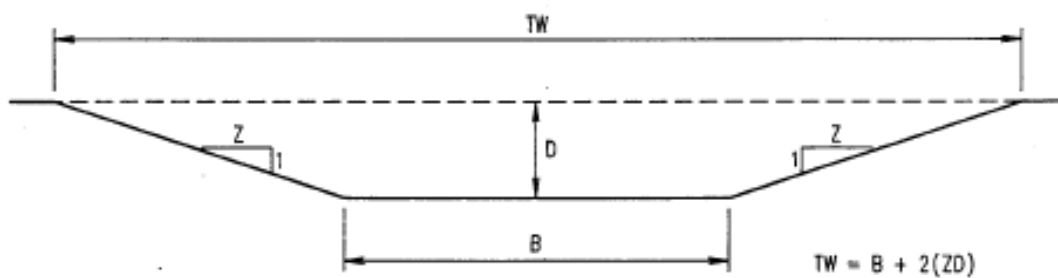
It is recommended (but not required) that shots be taken and recorded for the "0.5D – 3/8(TW)" quarter-points on parabolic waterways with top widths greater than 80 feet.

Checkout of waterways with triangular ("vee") cross sections may be recorded on [Form KS-ENG-39a](#). Indicate a zero distance between the centerline and edges of the waterway bottom and record only a center shot for the waterway bottom.

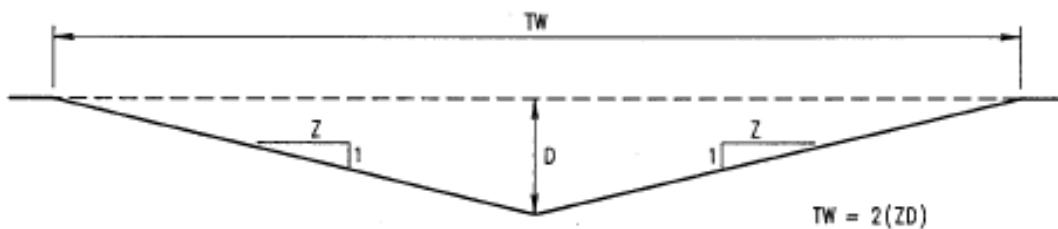
Figure 1--Typical Waterway Cross Sections



PARABOLIC CROSS SECTION



TRAPEZOIDAL CROSS SECTION




TW = TOP WIDTH  
 D = CONSTRUCTED DEPTH  
 B = BOTTOM WIDTH  
 Z = SIDE SLOPE RATIO

TRIANGULAR CROSS SECTION

Figure 2--Sample of Field Notes for Grassed Waterway (NRCS-ENG-28)

U. S. DEPARTMENT OF AGRICULTURE  
SOIL CONSERVATION SERVICE

SCD: <u>Blackdirt</u>	Date: <u>9-31-91</u>
Field Office: <u>Clay City</u>	(A)
Name: <u>I. M. Trying</u>	
<input checked="" type="radio"/> Individual <input type="radio"/> Group <input type="radio"/> Unit of Govt. <small>(circle one)</small>	
Job: <u>Grassed Waterway</u>	
Design Sur. <input checked="" type="checkbox"/>	Const. Layout <input checked="" type="checkbox"/>
Const. Check	Other
Ident. No.	Field No.
 See Field Sheet	
Scale	
<u>1"</u>	
Legal Description	
<u>SW 1/4</u> Sec <u>7</u>	T <u>77S</u> R <u>77W</u>
Location:	

SCS-ENG-28 REV. 5-75

Figure 3--Sample of Field Notes for Grassed Waterway (NRCS-ENG-29)

①

Station	B.S.	H.I.	F.S. or grade rod	Elev. or finished elev.
B.M.	1.5	101.5		100.0
			⑧	
0+00			3.5	98.0
1+00			8.2	93.3
2+00			12.1	89.4
T.P. 1	0.7	90.1	12.1	89.4
3+00			4.3	85.8
4+00			6.7	83.4
5+00			8.9	81.2
6+00			11.0	79.1
7+00			13.0	77.1
T.P. 2	1.1	78.2	13.0	77.1
8+00			3.0	75.2
9+00			4.7	73.5
10+00			6.0	72.2
11+00			7.1	71.1
12+00			8.0	70.2
13+00			9.3	68.9
T.P. 3	12.5	90.4	0.3	77.9
T.P. 4	13.5	102.7	1.2	89.2
B.M.			2.6	100.1 (o.k.)

SCS-ENG-29

(2-80)

CS 1 1997 0 - 11.4.51

I.M. Trying WW

9-31-91

①

B. Generic T  
R. Long &

Top of flagged fence post  
west of Sta 0+00  
Left Right

②

11.7	12.0	12.1	12.3	12.5
40	20	0	20	40

10.7	10.9	12.0	12.1	11.3
50	20	5	5	20
				40

54	6.0	6.2	7.1	5.9
50	20	5	0	5
				20
				5.5
				20
				5.3
				50
				50

①					②				
Station	B.S.	H.I.	F.S. or grade rod	Elev. or finished elev.	I.M. Trying WW	9-31-91	①		
B.M.	1.5	101.5		100.0					
			⑧						
0+00			3.5	98.0					
1+00			8.2	93.3					
2+00			12.1	89.4					
T.P. 1	0.7	90.1	12.1	89.4					
3+00			4.3	85.8					
4+00			6.7	83.4					
5+00			8.9	81.2					
6+00			11.0	79.1					
7+00			13.0	77.1					
T.P. 2	1.1	78.2	13.0	77.1					
8+00			3.0	75.2					
9+00			4.7	73.5					
10+00			6.0	72.2					
11+00			7.1	71.1					
12+00			8.0	70.2					
13+00			9.3	68.9					
T.P. 3	12.5	90.4	0.3	77.9					
T.P. 4	13.5	102.7	1.2	89.2					
B.M.			2.6	100.1 (o.k.)					



Figure 4--Sample Profile along Centerline of Trapezoidal Grassed Waterway

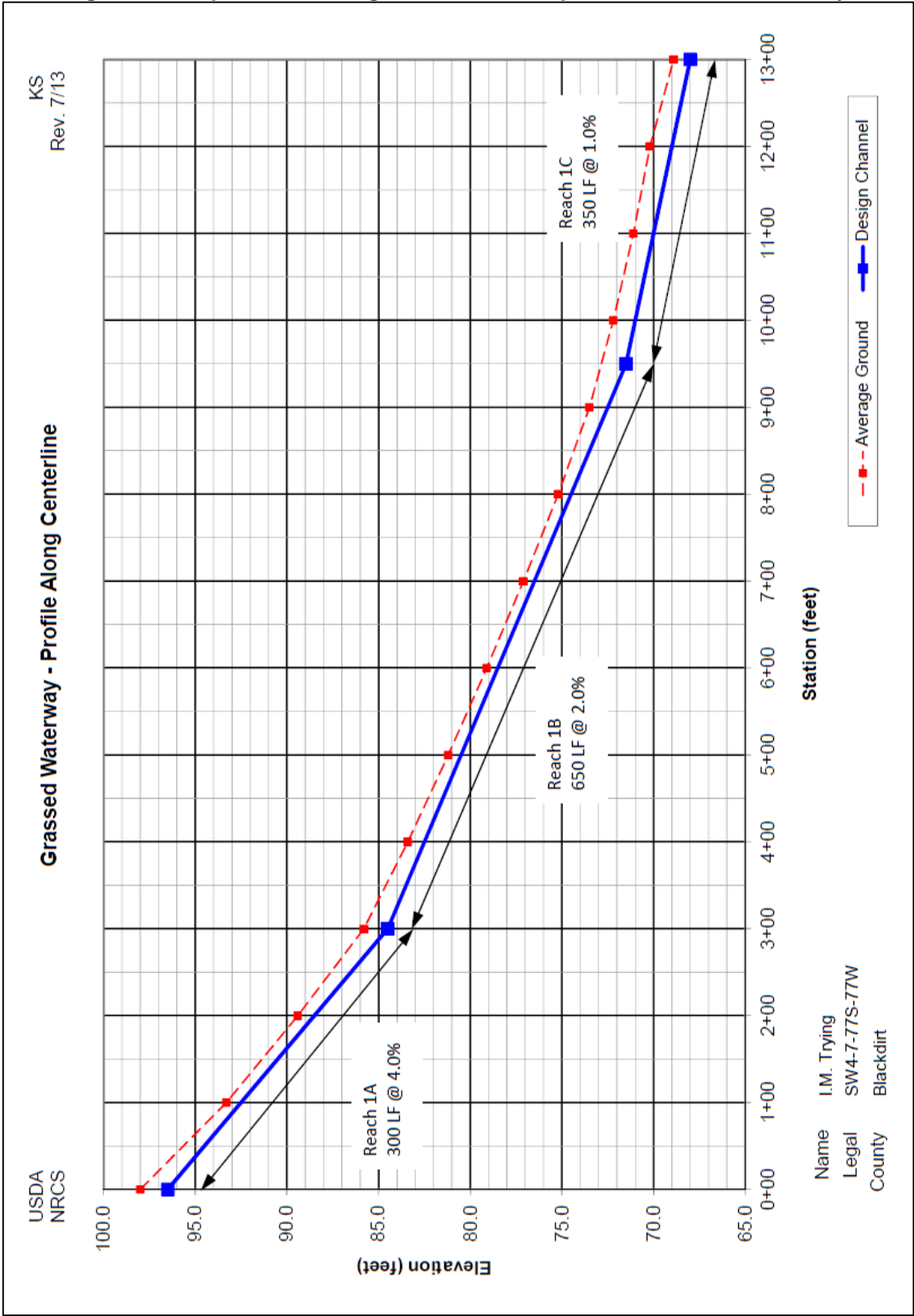


Figure 5--Sample Cross Sections of Trapezoidal Grassed Waterway

